THESIS/REPORTS
RMRS

Avian, Arthropod, and Plant Communities on Unburned and Wildfire Sites along the Middle Rio Grande

RWU 4351, Problem 2

2004 Annual Report to
Middle Rio Grande Conservancy District
Bosque del Apache National Wildlife Refuge

Avian, Arthropod, and Plant Communities on Unburned and Wildfire Sites along the Middle Rio Grande

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Introduction

Over the last century, riparian communities along the Middle Rio Grande in New Mexico have become increasingly xeric due in large part to increased fuel biomass (Busch 1995), long-term drought conditions, and flood control. Salt cedar (*Tamarix ramoisissima*) and Russian Olive (*Elaeagnus angustifolia*), highly invasive exotic plant species, not only make up a large percentage of the fuel biomass but also may outcompete native species such as Rio Grande cottonwood (*Populus deltiodes ssp. wislizeni*) by rapidly replacing them after wildfire events. These variables, along with contributing factors such as river regulation, have created an environment that appears to have induced increased wildfire frequency and intensity. Wildfire as a disturbance process is becoming increasingly important in desert riparian ecosystems and is a major issue of concern for land managers in New Mexico. Quantifying the immediate and long term responses of plants, animals, and water, to wildfire will aid in developing environmentally sound policies to manage ecosystems exposed to fire events, and develop knowledge regarding ecosystem responses to wildfire which can be used to justify wildfire management plans.

In 2001, the Rocky Mountain Research Station, in partnership with the Middle Rio Grande Conservancy District and the US Fish and Wildlife Service (Bosque del Apache NWR), initiated research to evaluate relationships between burn age, and successional responses of vegetation and avian populations (including evaluations of nesting success). In 2002, RMRS established a Research Joint Venture (02-JV-11221602-185) with the Oklahoma Biological Survey at University of Oklahoma (UO) to broaden the study to include research on cavity-nesting bird use of natural and artificial nest (nest boxes) and cicada responses to fire. The 2004 University of Oklahoma Progress Report to the Rocky Mountain Research Station is included in Appendix II.

Project Status

At the time of the 2004 season, wildfire sites ranged in age from 8 to 1 year post-burn, with fires occurring from 1996 to 2004.

June 2004 Wildfire Event

On June 18, 2004, immediately following a human-caused fire event along the river in the southern portion of Albuquerque, a wildfire occurred in Socorro County that affected one wildfire effect site (2002 Chavez Fire – MI4) and the control site for the South research block (SO1). The entire northern portion of South 1(SO1), consisting of a mature cottonwood stand, was destroyed by the fire. According to our estimates, roughly 6.1 acres (2.47 hectares) burned, including Point Count stations 1 and 2 and one herpetological array. The same fire also burned 9.0 acres (3.6 hectares) of previously unburned Bosque in the southern portion of MI4, displacing Point Count Stations 7, 8, one herpetological array, and one hydrological well. The fire not only interrupted the breeding season point count schedule but, more significantly, resulted in decreased nest monitoring activity during that time period. Due to safety concerns, both MI4 and SO1 could not be accessed for approximately 1 week after the fire. Access issues continued to create difficulties for the next month.

In 1999, Middle 4 (MI4) was established as one of the original RMRS Fuels Reduction research sites. Wildlife and vegetative data were collected during the 2000 and 2001 field seasons. In 2002, however, prior to the implementation of any fuels reduction treatments, approximately 80% of MI4 burned (Chavez Fire). Because of the existence of pre-and post-fire

avian and vegetative data sets from two separate wildfire events, we concluded that this site could provide much needed information about responses of riparian ecosystems to wildfire on the Rio Grande in New Mexico. The site was reclassified from a fuel reduction site to a wildfire site.

During the 2004 field season, monitoring of avian communities continued at wildfire and control sites using point count surveys, nest surveys, evaluations of nesting success, and measurements of nest site variables. Additional data collection also included vegetative measurements at some point count stations and limited hydrological monitoring.

Methodology

Study Design

This research was designed to quantify the effects of wildfire on the birds, vegetation, and hydrology of the Rio Grande Bosque. The objectives are to describe post-wildfire vegetative and wildlife communities, including habitat successional patterns and species population changes following wildfire. From 2001-2004, data were collected at three wildfire sites; Middle 6 (2000 Rio Grande Complex), South 5 (1996 San Pedro Fire - BNWR), and South 6 (1996 San Pedro Fire - BNWR) (Figure 1-3). Figures 1-3 also include University of Oklahoma research sites. Since the 2002 Chavez Fire event at Middle 4, data have been collected in 2003 and 2004 at this site as well. Data were also collected at another site, MI5 (2000 Rio Grande Complex) from 2001-2003, but will not be referred to in this report as the site was not surveyed in 2004. These burned areas were selected because of the existence of dominant pre-wildfire cottonwood riparian galleries. They were also large enough to examine impacts on plant communities and bird populations. Additionally, nearby unburned riparian forest with analogous vegetative structure and composition were selected as suitable control sites (MI7, SO1). These sites are also used as control sites for the RMRS Fuels Reduction Study. In the future, additional wildfire study control sites will be added, in conjunction with University of Oaklahoma sites.

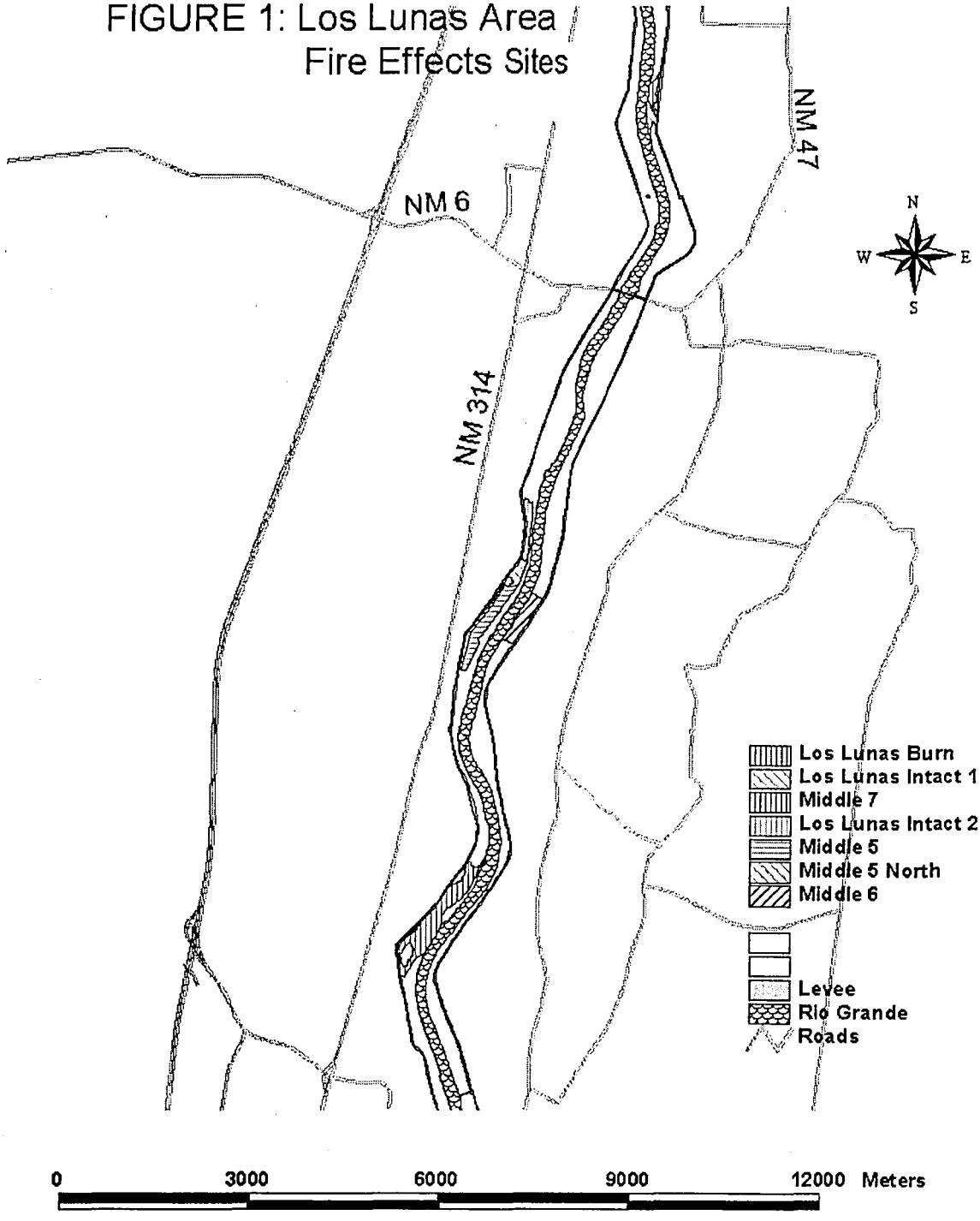
Assistance with research site selection was provided by the Middle Rio Grande Conservancy District (MRGCD), City of Albuquerque (COA), US Fish and Wildlife Service (USFWS), and New Mexico State Parks (NMSP).

Data Collection

Hydrology

Water plays a key role in the reestablishment and maintenance of plants disturbed by wildfires in the Middle Rio Grande Bosque. The sites in this study were disturbed by wildfire to some degree prior to the date at which monitoring of groundwater levels began (Table 1). Groundwater observation wells with recording data loggers were installed at each site to continuously monitor changes in groundwater levels. Groundwater levels are measured and recorded every 15 minutes by a pressure transducer. Plots of the depth to water at each site are presented in Appendix I.

FIGURE 1: Los Lunas Area
Fire Effects Sites



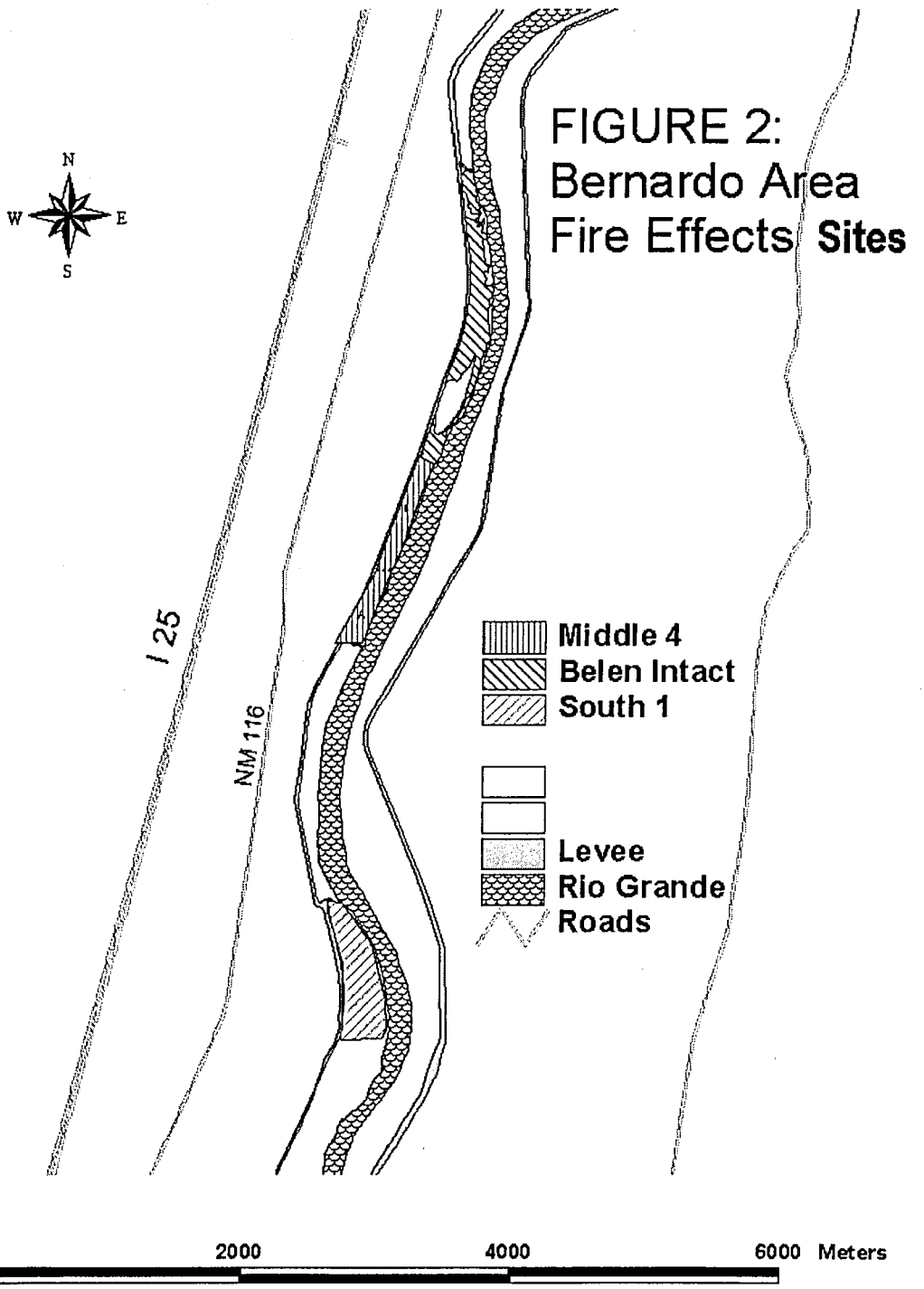


FIGURE 2:
Bernardo Area
Fire Effects Sites
N
W
E
S
I 25
NM 116
Middle 4
Belen Intact
South 1
Levee
Rio Grande
Roads
0
2000
4000
6000 Meters

FIGURE 3 Bosque del Apache NWR
Fire Effects Sites

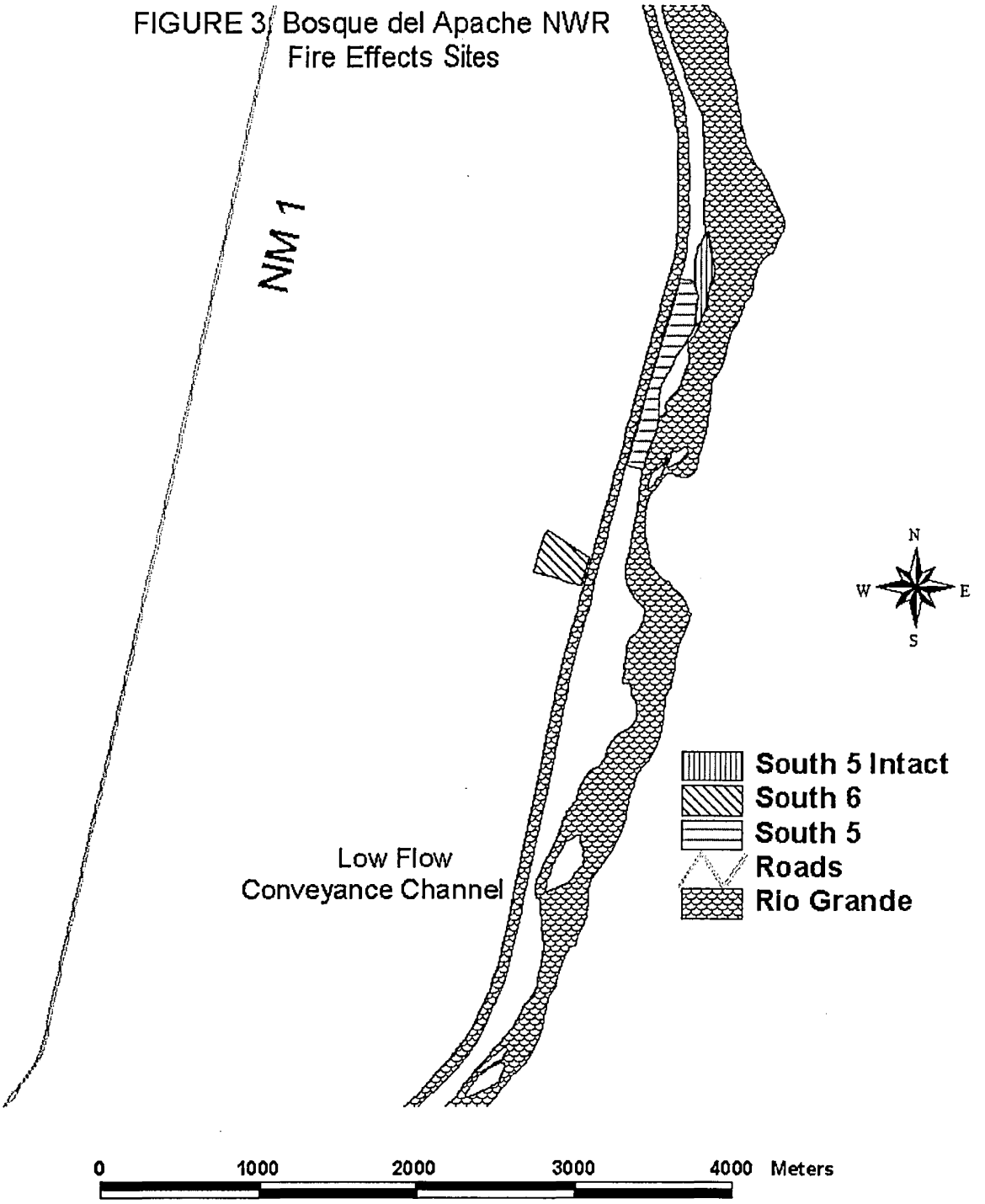


Table 1. Coordinates and characteristics of monitoring wells at fire sites.

Site ID	Coordinates of site corners and well locations (UTM WGS 84) NW	NE	SW	SE	North	South	Start Date	Depth to Water High / Low (cm)
Middle 4	3818456	3818414	3817098	3817090	3818161	3817556	6/2002	340
	334970	335087	334362	334566	334919	334690		507
Middle 5	3848654	3848631	3847513	3847399	3848249	3847873	7/2004	182
	341211	341343	340431	340609	341082	340791		307
Middle 6	3848001	3848002	3847369	3847478	3847788	3847555	7/2004	373
	341323	341555	341135	341208	341291	341150		506
South 5	3745198	3745055	3744938	3744848	3744988	3744921	7/2004	481
	328220	328469	328128	328423	328293	328274		423
South 6	3747576	3747588	3746215	3746211	3747119	3746663	7/2004	349
	329086	329188	328878	329091	329138	329131		511

Breeding Birds Surveys

Point Counts

At each study site, 3 to 8 point count stations were established along a north to south gradient based on global positioning system (GPS) coordinates. All stations were positioned approximately 150 meters apart, with the majority being 75 meters from boundaries. One point count station was established per 2.5 hectares.

Generally, the point count methods used in this research follow the recommendations of Bibby et al. (1992). All points were sampled an average of four times per season, with each transect surveyed in a north-south direction alternately. A round of surveys for all sites was completed before beginning a new round. Every attempt was made to perform point counts every other week during the 2004 breeding season. During each count, the observer at each point recorded all birds seen or heard for 8 minutes. Detection mode (heard, seen), sex, relative age of bird (AHY, HY), and distance from point (m) was also recorded. Species identification and distance estimations were checked across observers by informal testing throughout the sampling season. Each observer was trained to estimate and record distances to each bird. During the 2004 breeding season (summer), each transect was surveyed by 3 different individuals. In an effort to reduce observer bias and ensure accuracy, two of the observers had also performed surveys during previous seasons. All counts were conducted within the first four hours after sunrise with the first count beginning within half an hour of sunrise. Counts were conducted only on days without precipitation or strong wind. Before beginning each count, the observer waited for 1-2 minutes to allow birds to resume their normal behaviors.

Nest Searching and Monitoring

Each research site was searched for active nests on a regular and consistent basis (with the exception of the time surrounding the June 2004 wildfire) during the main breeding season

(05 May to 15 August, approximately). Nest data were recorded for each active nest at the time of nest discovery, observer(s) recorded a nest identification number, species identification, GPS location, directions to the nest (geographical and microscale), and a nest check record. Nest check records included dates of nest observations, nest stage, nest contents, and detailed observation notes. Nests were monitored until a nest fate was determined.

Additional behavioral observations were also recorded whenever possible. After the nesting season ended, nest substrate and placement data were measured at each nest. Data included nest height, location of nest in nest plant, nest composition, nest plant size, and condition of nest plant

Nesting Guilds

To identify trends in bird abundance among species nesting in similar substrates, we classified species using unburned and wildfire sites into nesting substrate guilds; canopy, cavity, and shrub/ ground (Baicich and Harrison 1997).

Vegetative Structure and Composition at Point Count Stations

Variable Plots

Plot centers were established approximately 25 meters from bird point count stations using the diagonal azimuth (i.e. NW). Azimuths were chosen in a predetermined order. Two plots were established at each point count station. A 2.5 m Basal Area Factor was utilized for the variable sampling plot. Each tallied tree was then identified to species, categorized as living or dead, and measured for DBH (diameter at breast height). In cases where a tree had more than one stem displaced by the prism, only the largest stem was counted. A densiometer was used to measure percentage of crown closure and readings were taken facing north and south by counting the number of closed points in each direction.

Fixed Plots

Two four- meter radius plots were established to characterize understory and ground cover characteristics at each site. All plants within the circular plots were identified and counted. Diameter at breast height measurements were recorded for woody plants with > 5 cm. DBH. These plants were also characterized as alive or dead and identified to species. For one plot at each point count station, all exotic woody plants were identified, counted, and measured for DBH. All perennial understory plants, as well as native trees and shrubs, within the plot radius were identified and counted. Forbs and grasses were counted or estimated at quantities of 1, 25, 50, or 100+. A fixed one-meter plot was also established at each point using the same center as the variable and four-meter plots. Within this plot, all live exotic stems >2 cm. in diameter were counted. Data from these plots can be used to estimate number of stems per acre.

Results

Hydrology

The primary source of groundwater in the Bosque is water that percolates into the ground from the river and canals that pass through the Bosque. Figure 4 illustrates the mean daily discharge of the Rio Grande measured at a USGS gage close to the research sites. Preliminary

graphs of ground water levels recorded at fire sites (MI4, MI5, MI6, SO5, and SO6) are displayed in Appendix I.

Direct precipitation is an important water source for germinating and recently established plants. In general, however, precipitation is not a major contributor to the groundwater levels in areas where it falls. Figures 5 and 6 summarize the precipitation recorded near the northern (Los Lunas) and southern limits Bosque del Apache National Wildlife Refuge of our study sites.

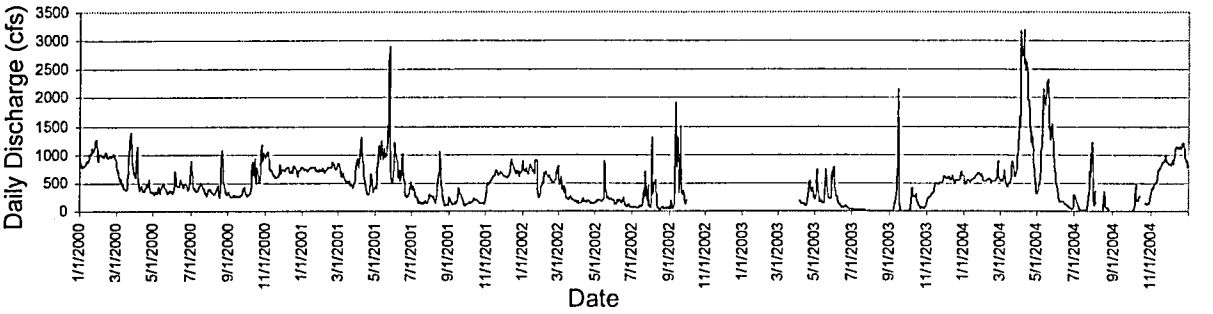
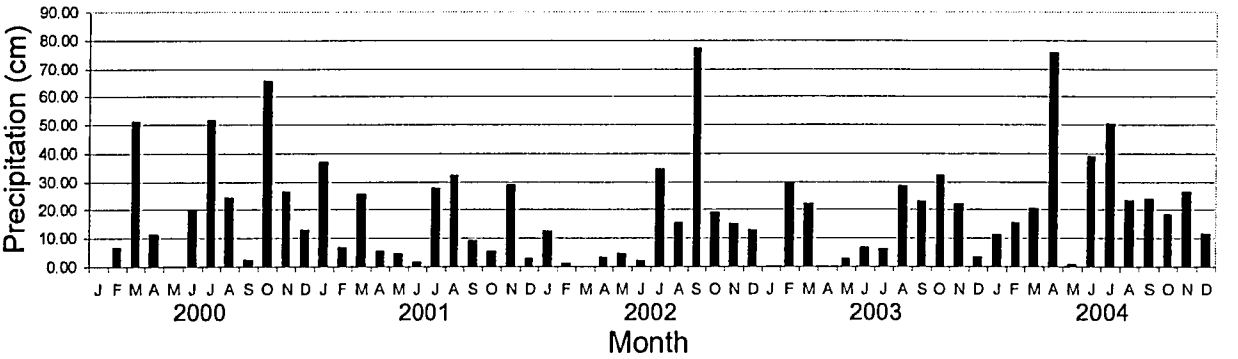


Figure 4. Rio Grande discharge at USGS gage 08354900 near middle study blocks at San Acacia, NM (U.S. Geological Survey 2005).


Precipitation (cm)
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
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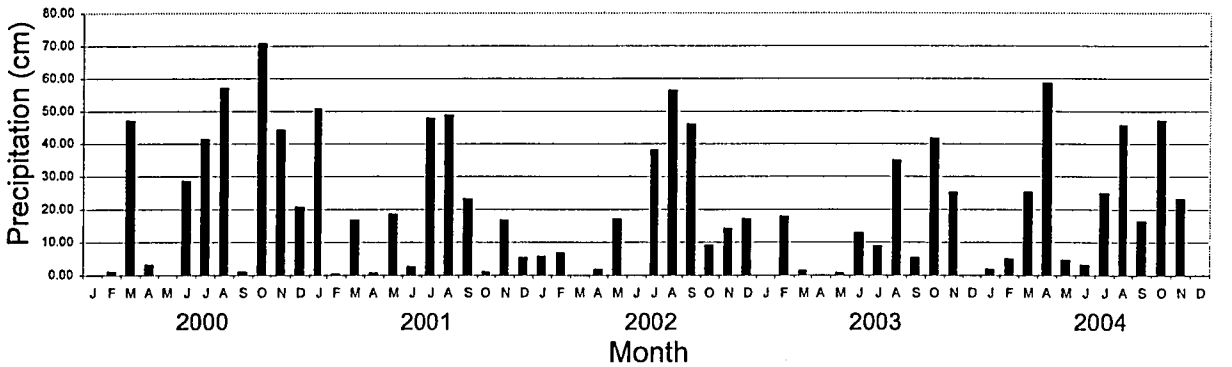
Month

Figure 5. Precipitation at Los Lunas, NM (Western Regional Climate Center 2005).


Precipitation (cm)
80.00
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2000
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2003
2004
Month

Figure 6. Precipitation recorded at Bosque del Apache southeast of Socorro, NM (Western Regional Climate Center 2005).

Breeding Bird Surveys

Point Counts

We detected a total of 63 different bird species (mean 258.25/ site) at wildfire sites and 44 species (mean 363.00 /site) at unburned sites during 4 rounds of point count surveys (Table 2). Table 3 represents the most common species (24) detected at wildfire sites (14.99/point) and most common 19 species (11.03/point) seen at unburned sites. As mentioned previously, the June wildfire disrupted the breeding season point count schedule at Middle 4 and South 1 in Abeytas. Subsequently, any point count information from post-fire point count stations will not be included in this report.

This year's breeding season survey data indicate a possible shift in avian abundance from previous years. The most frequently seen species at all post-burn sites in 2004 were, in descending order, Brown-headed Cowbirds (*Molothrus ater*), Black-headed Grosbeaks (*Pheucticus melanoceplahus*)(equal rate to cowbirds), Bewick's Wrens (*Thryomanes bewickii*), Yellow-breasted Chats (*Icteria virens*), and Red-winged Blackbirds (*Agelaius phoeniceus*). For the past several years, Black-chinned Hummingbirds (*Archilochus alexandri*) and Mourning Doves (*Zenaida macroura*) have had consistently high (usually the highest) detection rates at most research sites. In 2004, the number of Mourning Dove detections declined and Hummingbird detections stayed relatively constant, while the number of Black-headed Grosbeaks nearly doubled (Table 3).

A common host of nest parasitism by Brown-headed Cowbirds, Black-headed Grosbeaks, had the highest number of detections recorded at wildfire sites and the second highest at control sites (Table 2). Yellow-breasted Chats and Blue Grosbeaks (*Passerina caerulea*) also had high rates of detection at wildfire sites (1.54/point and 0.92/point, respectively). The existence of a large number of individuals of these host species may explain the high incidence of cowbirds present at the sites. Because of definitive evidence of parasitism at several of the nests monitored during the 2004 season, Brown-headed cowbird parasitism will also be discussed in the section on *Nest Monitoring*.

In future analyses, point count data will be converted to bird abundance results using the Program DISTANCE.

Table 2. Total number of detections of avian species at RMRS wildfire and control sites during breeding season surveys, 2003-2004.

	Number of Individuals			
	2003		2004	
Species	**Wildfire**	**Control**	**Wildfire**	**Control**
Canada Goose	3	4	6	0
Wood Duck	1	0	1	2
Gadwall	2	0	0	0
Mallard	43	20	10	0
Northern Pintail	3	2	0	0
Northern Shoveler	0	0	1	0
Ring-necked Pheasant	43	23	25	12
Gambel's Quail	7	1	6	0
American White Pelican	3	0	0	0
Great Blue Heron	3	1	1	0
Snowy Egret	6	0	0	0
Black-crowned Night-Heron	4	0	1	0
Turkey Vulture	11	0	60	0
Cooper's Hawk	7	4	0	3
Swainson's Hawk	2	1	1	3
Red-tailed Hawk	1	0	0	0
American Kestrel	26	2	19	0
Great Horned Owl	0	0	0	1
Killdeer	6	0	12	0
Spotted Sandpiper	1	0	11	3
Belted Kingfisher	0	0	0	1
White-winged Dove	1	0	2	0
Mourning Dove	208	79	75	69
Yellow-billed Cuckoo	6	1	5	0
Greater Roadrunner	22	1	2	1
Black-chinned Hummingbird	87	140	58	91
Ladder-backed Woodpecker	4	4	2	0
Downy Woodpecker	9	6	7	7
Hairy Woodpecker	12	2	4	3
Northern "Red-shafted" Flicker	30	19	11	12
Western Wood-Pewee	29	25	16	11
Dusky Flycatcher	7	0	4	1
Black Phoebe	2	0	0	1
Ash-throated Flycatcher	79	99	48	81
Western Kingbird	36	2	26	3
Plumbeous Vireo	0	0	1	0
"Solitary" Vireo	6	0	0	0
Warbling Vireo	1	0	3	0
American Crow	16	20	1	0
Chihuahuan Raven	2	0	2	0

Common Raven	14	17	3	0
Violet-green Swallow	1	6	0	0
Northern Rough-winged Swallow	2	1	1	0
Bank Swallow	7	0	2	0
Cliff Swallow	17	3	13	3
Barn Swallow	22	6	4	10
Black-capped Chickadee	11	38	4	20
Bushtit	10	9	4	1
White-breasted Nuthatch	21	38	16	22
Bewick's Wren	101	85	72	42
House Wren	1	0	0	0
Ruby-crowned Kinglet	4	0	0	0
American Robin	35	2	22	3
Gray Catbird	12	1	1	3
Northern Mockingbird	2	0	2	0
European Starling	1	1	0	3
Cedar Waxwing	0	0	0	4
Phainopepla	2	0	1	0
Orange-crowned Warbler	1	0	0	0
Virginia's Warbler	2	0	0	0
Lucy's Warbler	11	12	4	15
Yellow-rumped "Audubon's" Warbler	8	1	1	1
MacGillivray's Warbler	1	0	1	0
Common Yellowthroat	25	2	23	0
Wilson's Warbler	6	0	5	0
Yellow-breasted Chat	161	38	138	23
Summer Tanager	35	46	13	23
Western Tanager	3	0	0	0
Spotted Towhee	152	88	79	53
Chipping Sparrow	8	0	0	1
Lark Sparrow	7	0	1	1
White-crowned Sparrow	4	0	0	0
Black-headed Grosbeak	94	117	179	84
Blue Grosbeak	113	47	100	25
Lazuli Bunting	4	0	5	1
Indigo Bunting	19	0	12	1
Red-winged Blackbird	110	11	94	16
Western Meadowlark	8	23	9	11
Yellow-headed Blackbird	2	0	0	0
Common Grackle	10	1	1	0
Great-tailed Grackle	20	2	0	0
Brown-headed Cowbird	182	46	159	43
Bullock's Oriole	13	5	6	8
House Finch	18	3	23	4
American Goldfinch	1	4	0	0
Lesser Goldfinch	19	22	14	0
Other (domestic species)	6	13	0	0

Total Individuals	**2035**	**1144**	**1433**	**726**
Total Species	**82**	**51**	**63**	**44**

Table 3. Number of detections of common avian species at RMRS Wildfire (burned) and Control (unburned) sites 2003-2004.

	Wildfire				Control			
	2003		2004		2003		2004	
Species	Total[a]	Mean[b]	Total[c]	Mean[b]	Total[d]	Mean[b]	Total[e]	Mean[b]
American Kestrel (*Falco sparverius*)	26	0.22	19	0.24	2	0.03	0	0
American Robin (*Turdus migratorius*)	35	0.29	21	0.53	2	0.03	0	0
Ash-throated Flycatcher (*Myiarchus cinerascens*)	79	0.66	49	0.01	99	1.24	81	1.35
Barn Swallow (*Hirundo rustica*)	22	0.18	0	0	6	0.08	10	0.17
Black-capped Chickadee (*Poecile atricapillus*)	11	0.09	0	0	38	0.48	20	0.33
Black-chinned Hummingbird (*Archilochus alexandri*)	87	0.73	58	0.78	140	1.75	91	1.52
Bewick's Wren (*Thryomanes bewickii*)	101	0.85	72	1.73	85	1.06	42	0.7
Brown-headed Cowbird (*Molothrus ater*)	182	1.53	159	1.95	46	0.85	43	0.72
Black-headed Grosbeak (*Pheucticus melanocephalus*)	94	0.79	179	1.95	117	1.46	84	1.4
Blue Grosbeak (*Passerina caerulea*)	113	0.95	100	0.92	47	0.59	25	0.42
Common Yellowthroat (*Geothlypis trichas*)	25	0.21	22	0.24	2	0.03	0	0
House Finch (*Carpodacus mexicanus*)	18	0.15	23	0.25	3	0.04	0	0
Indigo Bunting (*Passerina cyanea*)	19	0.16	12	0.13	0	0	0	0
Lesser Goldfinch (*Carduelis psaltria*)	19	0.16	14	0.15	22	0.28	0	0
Lucy's Warbler (*Vermivora luciae)*	11	0.09	0	0	12	0.15	15	0.25
Mallard (*Anas platyrhynchos*)	43	0.36	10	0.11	20	0.25	0	0
Mourning Dove (*Zenaida macroura*)	208	1.75	75	0.82	79	0.99	69	1.15
Northern Flicker (*Colaptes auratus*)	30	0.25	11	0.12	19	0.24	12	0.2
Ring-necked Pheasant (*Phasianus colchicus*)	43	0.36	25	0.27	23	0.29	12	0.2
Red-winged Blackbird (*Agelaius phoeniceus*)	110	0.92	94	1.02	11	0.14	16	0.26
Spotted Towhee (*Pipilio crissalis*)	152	1.28	79	0.86	88	1.1	53	0.88
Summer Tanager (*Piranga rubra*)	35	0.29	13	0.14	46	0.58	23	0.38
Turkey Vulture (*Cathartes aura*)	11	0.09	60	0.65	0	0	0	0
White-breasted Nuthatch (*Sitta carolinensis*)	21	0.18	16	0.17	38	0.48	22	0.36
Western Kingbird (*Tyrannus verticalis*)	36	0.3	22	0.24	2	0.03	0	0

Western Meadowlark (*Sturnella neglecta)*	8	0.07	0	0	23	0.29	11	0.18
Western Wood-Pewee (*Contopus sordidulus*)	29	0.24	16	0.17	25	0.31	11	0.18
Yellow-breasted Chat (*Icteria virens*)	161	1.35	142	1.54	38	0.48	23	0.38
Total Species	**28**		**24**		**26**		**19**	
Total Individuals	**1729**		**1291**		**1033**		**663**	

[a]total number of individuals detected/5 surveys/4 sites

[b]mean detection rate/point

[c]total number of individuals detected/4 surveys/4 sites

[d]total number of individuals detected/5 surveys/2 sites

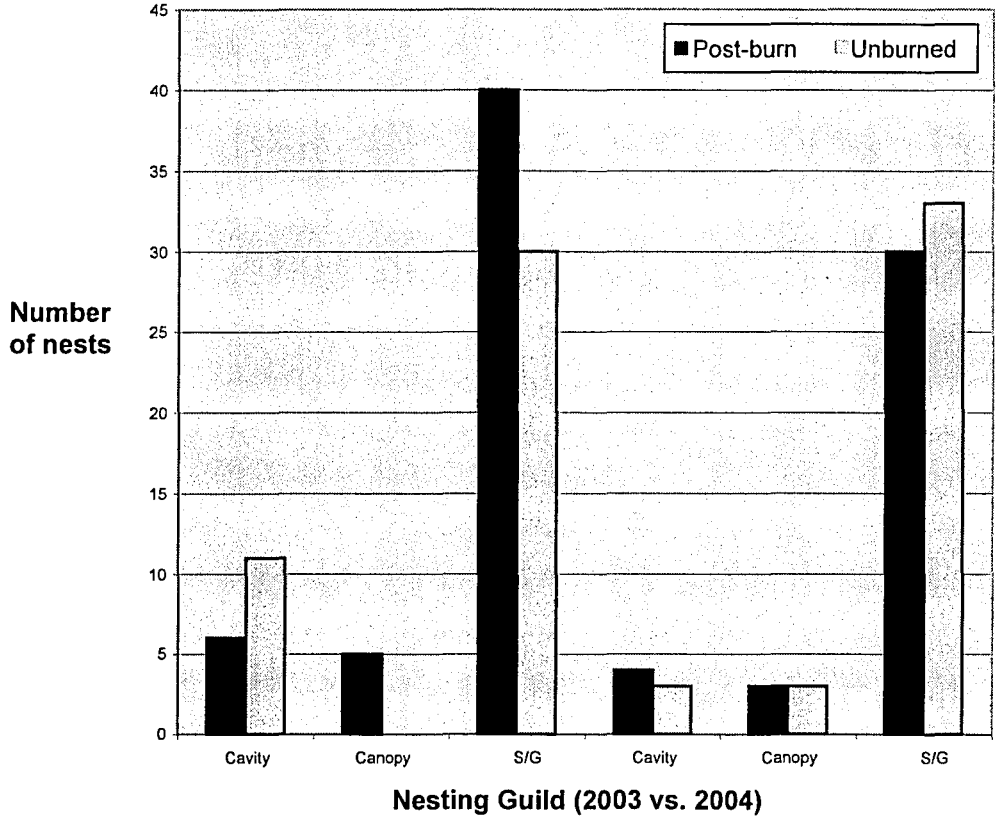
[e]total number of individuals detected/4 surveys/2 sites

Nest Monitoring

A total of 37 nests, representing 11 species, were monitored at wildfire sites during the 2004 field season. In addition, 39 nests, of 12 species, were located at unburned sites (Table 4). Nests with 'unknown' nest fate determinations are not included in this report. Six of the avian species nesting at burned sites were observed nesting at unburned sites (Black-chinned Hummingbirds, Black-headed Grosbeaks, Blue Grosbeaks, European Starlings, Mourning Doves, and Western Kingbirds). Mourning Dove nests were the most frequently located, with the highest number of dove nests located at Middle 6 (2000 Rio Grande Complex Fire – 4 year post-burn). Site selection by Mourning Doves is most likely related to site fidelity and availability of nest substrates of use to doves. Nesting success of Mourning Doves appeared to be negatively effected by predation at wildfire sites, with a 57% failure rate (Table 4). Although the Black-chinned Hummingbird has been a common nesting species at study sites along the Rio Grande, we did not find marked differences in numbers of nests at post-burn ($\geq$ 8 years) versus unburned riparian habitat (Table 4). At RMRS wildfire sites, all monitored hummingbird nests were located exclusively in exotic plant species.

Some disparity between nest numbers and fates between sites may be attributed to gaps in nest monitoring (June 2004 fire) and inability to access all available nesting areas due to dense undergrowth and time constraints. We have re-structured our sampling protocol in future years to address this problem.

Figure 7. Total number of nests (by nesting guild) at RMRS wildfire (post-burn) and control (unburned) sites, 2003-2004.



Brown-headed Cowbird Parasitism

Hoffman (1990) found, as did we (RMRS Fuels Reduction and Fire Effects Reports, 2000-2002, 2003), that Brown-headed Cowbirds are fairly common in the Middle Rio Grande Valley during the breeding season. Of the 12 nests of known cowbird hosts (Blue Grosbeak, Black-headed Grosbeak, and Yellow-breasted Chat) monitored at RMRS wildfire and control sites in 2004, 8 nests were parasitized by cowbirds. We believe that nest failure at 6 of the parasitized nests can be directly attributed to cowbird parasitism. Approximately 72% of all Blue Grosbeak nests exhibited evidence of Brown-headed Cowbird parasitism, suggesting that further evaluation of this host/cowbird relationship may be merited.

Because of their potentially negative effect on productivity of host populations, cowbirds may play an important role in structuring avian communities in southwestern riparian habitats. Robinson et al. (1993) suggest that the Brown-headed Cowbird is a major threat to neotropical migrants during the breeding season. Understanding and managing for the influence of habitat and wildfire on cowbird parasitism rates and host nesting success may be useful for mitigating negative impacts on hosts by cowbirds. We plan to pursue this question in more detail during the 2005 breeding season .

Vegetation Measurement

Although fuel load and vegetative measurements were recorded at many sites, data sets are still incomplete, with additional measurements required. Vegetative structure and composition at wildfire study sites will be addressed in the 2005 Progress Report.

Research Concerns

Avian Use of Course Woody Debris

Fire is a major natural agent of disturbance along the Middle Rio Grande. Although wildfires (whether caused by natural or unnatural events) tend to burn in these areas at high intensities, fire size is comparatively small and thus may produce smaller amounts of downed woody material (DWM) than fires in heavily forested areas. Downed woody material (DWM), also described as course woody debris, is defined as standing dead trees, downed trees (logs), and large branches (Bull, 2002). Stand destroying events typically create large amounts of DWM which, in turn, create a suitable habitat for many species of wildlife (Bunnell et al., 2002). Even though high-intensity fire events may, in some cases, actually remove more material than they add, they can still provide crucial habitat.

Many bird species, such as Bewick's Wrens and Ash-throated Flycatchers, use coarse woody debris for nesting, roosting, foraging, and shelter (Miller 1941). In 2004, both Bewick's Wrens and Ash-throated Flycatchers were detected during point count surveys at wildfire and control sites, but no natural nests were located. Although each species has different microhabitat foraging requirements, both are secondary cavity nesters. The absence of natural nests of both species at RMRS research sites may indicate a lack of availability of critical nesting habitat components. We suggest that high-intensity fire events, in areas where a high concentration of exotics exist, may eliminate more material than they create. Additionally, salt-cedar habitat may be unsuitable or marginal for breeding by cavity-nesting species because stems are too small for nest cavities (Busch 1981).

Table 4. Nesting success of common breeding birds, by nesting substrate guild at RMRS wildfire and control sites (2003-2004).

	2003				2004			
Species	**Wildfire**	**%Success**	**Control**	**%Success**	**Wildfire**	**%Success**	**Control**	**%Success**
Cavity*								
American Kestrel	1	100.00	0	NA	1	100.00	0	NA
Ash-throated Flycatcher	1	100.00	3	100.00	0	NA	0	NA
Barn Owl	1	100.00	0	NA	0	NA	0	NA
Downy Woodpecker	1	100.00	1	100.00	0	NA	2	50.00
European Starling	0	NA	1	100.00	1	100.00	1	100.00
Hairy Woodpecker	1	100	0	NA	0	NA	0	NA
Northern (RS) Flicker	1	100	4	100.00	1	100.00	0	NA
White-breasted Nuthatch	0	NA	1	100.00	1	100.00	0	NA
Ladder-backed Woodpecker	0	NA	1	100.00	0	NA	0	NA
Total	**6**		**11**		**4**		**3**	
Canopy*								
Bullock's Oriole	1	100.00	0	NA	1	100.00	0	NA
Bushtit	1	100.00	0	NA	0	NA	0	NA
Cooper's Hawk	1	100.00	0	NA	0	NA	0	NA
Great-horned Owl	0	NA	0	NA	0	NA	1	100.00
Summer Tanager	0	NA	0	NA	0	NA	1	0.00
Western Kingbird	2	100.00	0	NA	1	100.00	1	100.00
Yellow-billed Cuckoo	0	NA	0	NA	1	100.00	0	NA
Total	**5**		**0**		**3**		**3**	
Shrub/Ground*								
Black-chinned Hummingbird	9	67.00	17	71.00	3	67.00	13	62.00

Black-headed Grosbeak	1	0.00	1	0.00	1	100.00	4	75.00
Blue Grosbeak	9	33.00	3	33.00	7	43.00	2	50.00
Gray Catbird	0	NA	0	NA	0	NA	1	100.00
Greater Roadrunner	0	NA	0	NA	0	NA	1	100.00
Indigo Bunting	1	100.00	0	NA	0	NA	0	NA
Mourning Dove	20	15.00	7	43.00	19	26.00	11	45.00
Spotted Towhee	0	NA	2	100.00	0	NA	1	100.00
Total	**40**		**30**		**30**		**33**	
Total (all sites/year)	**51**		**41**		**37**		**39**	

*species divided by nesting substrate guild (Baicich and Harrison 1997)

Because post-fire plant communities along the Rio Grande are often dominated by exotic understories, we suggest that spread of salt-cedar may negatively influence abundance and productivity of Ash-throated Flycatchers and other cavity-nesting species. Flycatchers require open foraging habitat (Cardiff and Dittmann 2002), and disturbance factors that result in closure of habitats may also affect flycatcher abundance. We will explore relationships between population abundance of cavity-nesters and disturbance by fire in future years.

Invasive Plant Species at Wildfire Sites

Plant invasions can alter native ecosystems by changing fuel properties and subsequently affecting fire behavior characteristics such as frequency, intensity, seasonality, extent, and type of fire (Brooks et. al., 2004). Rapid regeneration of invasive species (salt cedar, in particular) at Middle Rio Grande sites immediately following wildfire events may create an invasive plant-fire regime cycle which, in turn, may make reestablishment of native plant communities extremely difficult.

Future Considerations

During the 2005 field season, the Rocky Mountain Research Station will perform its first season of nest searching and monitoring at the UO Bernardo 2003 post-burn site, as well as begin monitoring of UO nest boxes at BNWR sites. We will continue collection of avian information; nest searching and monitoring, point count surveys, and the remaining vegetative and fuel load measurements. RMRS will also broaden the research scope by establishing point count stations at the Bernardo site for use starting in the 2006 field season. Pending land-owner/manager approval, one additional study site may also be added. Continued monitoring and analysis of the hydrological inputs to the Bosque following wildfires, along with information about vegetation and soils, will help us develop a better understanding of the role that water plays in the reestablishment and maintenance of the Bosque.

In 2006, RMRS plans to integrate University of Oklahoma Biological Survey sites into the Wildfire Study, following graduation and departure by Max Smith. This incorporation will include; continuing nest box monitoring and monitoring resprouting vegetation. By creating additional study sites and expanding research goals, we hope to provide a more comprehensive representation of successional responses of Middle Rio Grande riparian habitat to wildfire events.

Acknowledgements

The RMRS would like to express its appreciation to the MRGCD (Middle Rio Grande Conservancy District – Yasmeen Najmi), University of Oklahoma Biological Survey (Dr. Jeff Kelly, Max Smith), and the USFWS (Bosque del Apache National Wildlife Refuge) for their continued support. We also wish to thank RMRS seasonal field crews and, in particular, David Hawksworth. In closing, we wish to (post-humorously) acknowledge the many contributions of John Taylor, senior wildlife biologist for the Bosque del Apache National wildlife Refuge. John, who passed away in September of 2004, provided invaluable guidance and assistance with RMRS projects at the Refuge over the past decade. John was a well-respected scientist and community leader, as well as a friend to many station employees. He will be greatly missed.

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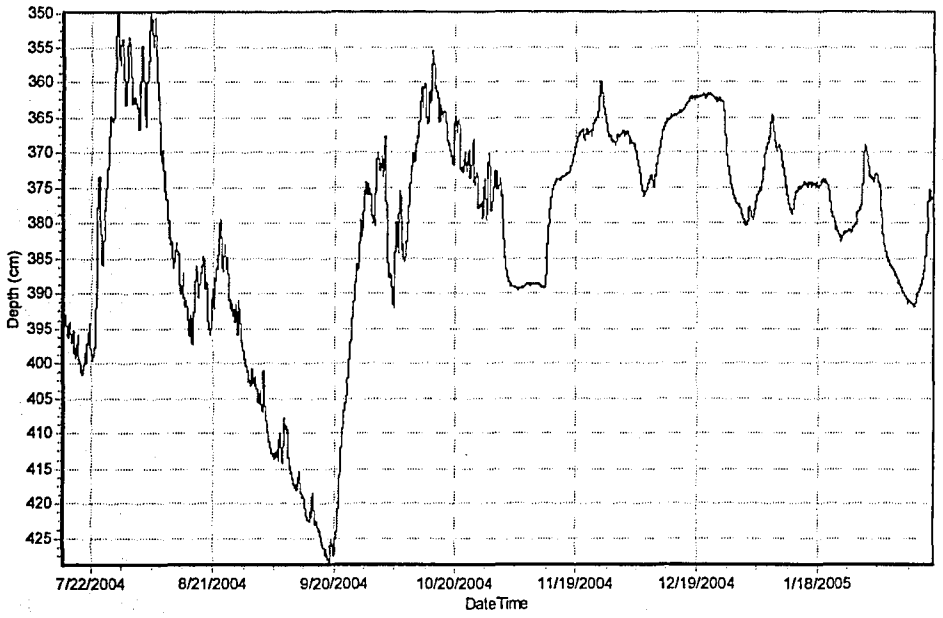
Appendix I

Preliminary graphs of ground water levels recorded at fire sites. Note that depth to water is from the top of the well casings, which is approximately 80 cm above the ground surface.

Middle 4: 7/15/2004-2/15/2005



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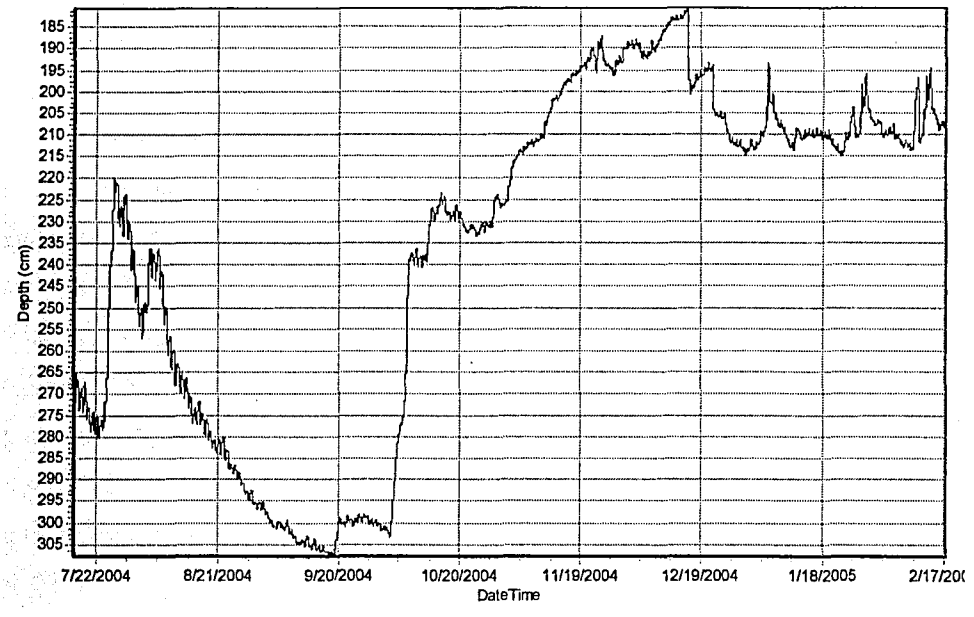

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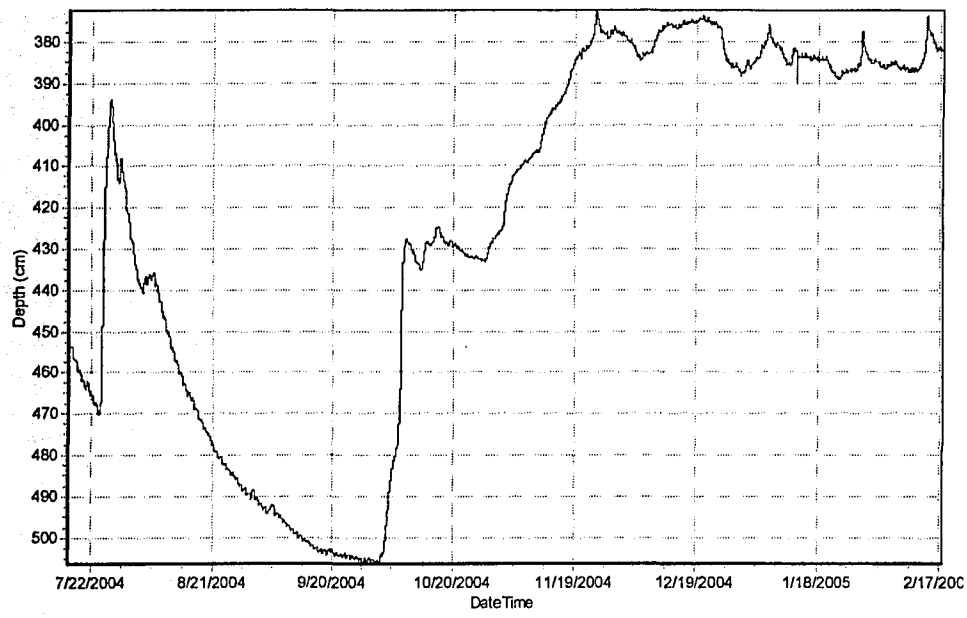
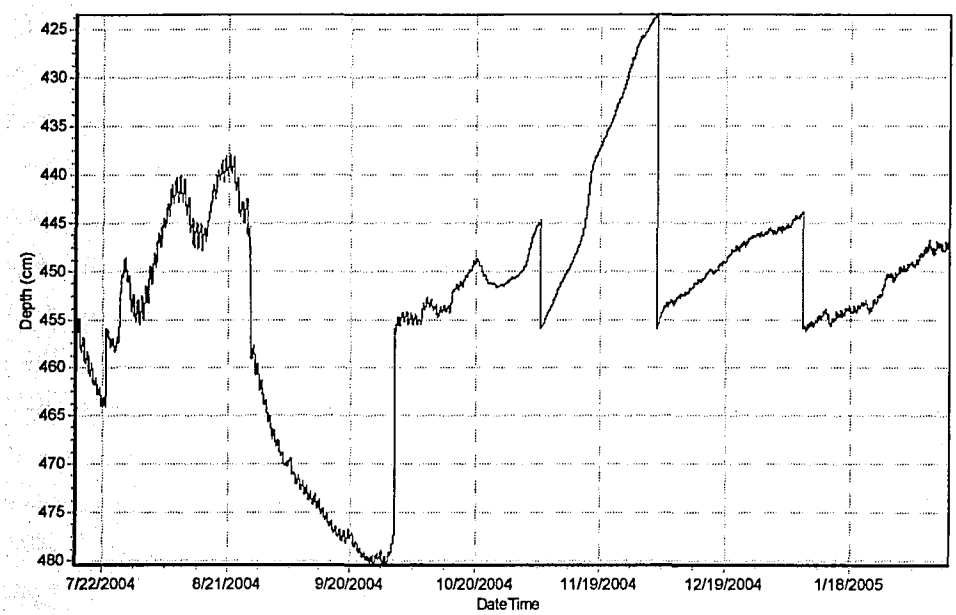
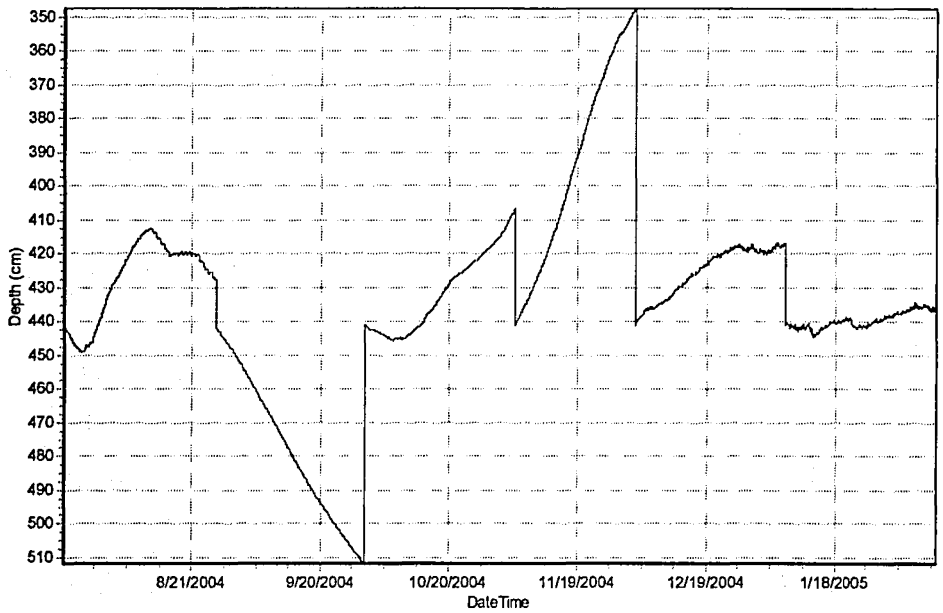


South 5: 7/15/2004-2/10/2005



South 6: 7/22/2004-2/10/2005



Appendix II

2004 Progress Report for Wildfire Effects Research (Joint Venture #02-JV-11221602)

Prepared by: Max Smith

Oklahoma Biological Survey and University of Oklahoma Department of Zoology

As part of a joint-venture agreement with the Rocky Mountain Research Station, I conducted research for my Master's thesis during the summer of 2004 in the Middle Rio Grande Bosque. The purpose of this research is to evaluate the quality of riparian habitats for breeding birds. To quantify habitat quality, I focused on comparing vegetation structure and arthropod abundance in wildfire and unburned sites. In addition, I compared nesting success of birds that used nest boxes installed in wildfire and unburned sites.

Methodology

UO Study Sites

As in 2003, data were collected in paired and unpaired wildfire and unburned sites (Table 1). University of Oklahoma research was conducted in the Rio Grande Bosque in Valencia and Socorro counties, New Mexico. Wildfire sites were chosen based on location, year of fire, and post-fire management history. Unburned sites were chosen for their location (adjacent to each wildfire site) and comparative vegetation structure, resembling pre-wildfire conditions in burn areas. Three pairs of sites are located on land managed by the MRGCD and one pair is managed by the USFWS (Bosque del Apache National Wildlife Refuge).

Nest Box Monitoring

I installed a total of 99 nest boxes at all sites prior to the 2004 nesting season. I placed similar numbers of nest boxes in wildfire and unburned sites (Table 1.). During the summer, I checked each box regularly to determine use and measure nestlings every three days. All nestlings were banded with aluminum Fish and Wildlife Service bands when they were at least six days old. I considered a nest successful when the boxes were empty and the nestlings were known to be fledging age, or if fledglings were observed outside the nest. During the nestling stage I recorded adult behavior with a camcorder several meters from the nest box to determine feeding rates and prey selection. I am currently reviewing tapes in Oklahoma.

Ground Arthropod sampling

To quantify arthropod prey on the ground and in leaf litter, I installed a set of four pitfall traps around each nest box. Each set of traps was opened for three days in the early summer (May 15-June 30) and three days in the late summer (July 1-August 15). The three-day periods were randomly selected for each nest. I am identifying and sorting captured arthropods in Oklahoma.

Cicada Sampling

Riparian cicadas emerge each year and are an important resource for breeding birds (Rosenberg et al 1982). To determine their response to wildfire, I installed emergence traps in wildfire and unburned sites. Emergence traps resemble a small tent without a floor and cover one meter of ground. Cicadas are trapped as nymphs emerge from the ground to become adults. I am using the traps to compare emergence density and timing of emergence between wildfire and unburned sites. I installed 11 to 14 traps in unburned and wildfire sites (Table 1). I checked the traps every three days to count and remove any cicadas inside.

Vegetation Measurement

To describe changes in vegetation structure following wildfire and to identify nest-site preferences of birds, I measured vegetation characteristics at each nest site. At each nest, I established 11.3-meter radius plots and identified and measured all trees and shrubs inside. I also quantified foliage height diversity, canopy cover and ground cover.

I measured vegetation at all cicada-trapping sites to relate plant community composition to emergence densities. At each trap site, I recorded proximity to nearest tree and shrub species, size of nearest shrubs and trees, and condition of shrubs and trees.

To describe vegetation recovery in wildfire sites, I am measuring growth and survival of re-sprouting stems. In 2003, I randomly selected and measured stems sprouting from top-killed trees and shrubs. Stems included native and exotic species (Table 2). In 2004, I relocated and re-measured each stem to estimate survival and growth rates across sites. Wells have been established at wildfire sites to measure water table depths. This information will be used to explain differences in survival and growth of native versus exotic re-sprouts.

Initial Results

Nest Box Monitoring

As in the previous summer, Ash-throated Flycatchers (*Myiarchus cinerescens*) and Bewick's Wrens (*Thyromanes bewickii*) were the only bird species to use the nest boxes. Bewick's Wrens nested in 17 boxes (18% of those installed), which was fewer than the 23% used in 2003. Ash-throated Flycatchers used 18 boxes (19%) an increase from 9% used in 2003. In 2003 and 2004, flycatchers appeared to prefer nest boxes in wildfire sites while wrens preferred boxes in unburned sites (Figure 1).

Nest success for flycatchers and wrens was lower in 2004 than in 2003. For flycatchers, 61% of nests were successful, 17% were abandoned, and 22% were depredated. For wrens, 71% of nests were successful, 5% were abandoned, and 18% were depredated. Nest predation was higher in wildfire sites than in unburned sites (Figure 2). One wren nest appeared to have been depredated by a raccoon because material had been pulled out from the entrance and a raccoon denned nearby. Contents of the other depredated nests appeared to have been consumed by snakes because nest material was not disturbed. In addition, I observed many snakes near the nest box sites in 2004, including coachwhips (*Masticophis flagellum*), which are capable of climbing trees to enter nests (Degenhardt et al. 1996).

Cicada Sampling

Cicadas continued to emerge in wildfire sites as well as in unburned sites. There were no significant differences between emergence densities in unburned and wildfire sites. There were, however, differences in timing of emergence (Figure 3). Cicadas initiated and terminated emergence earlier in wildfire sites than in unburned sites.

Vegetation Measurement

Two hundred and fifty-four of the 258 stems marked in 2003 were relocated in 2004. Those not relocated were likely destroyed by post-fire management, browsing, or tree falls. Survival of saltcedar stems was 100% at all sites while survival of native vegetation such as cottonwood was high in older wildfire sites but low in recently burned sites (Table 3).

Future Considerations

I will conduct my final field season in 2005 during which I will conduct an experiment to determine effects of early cicada emergence on nesting success of Ash-throated Flycatchers. In addition, I will complete measurement of marked re-sprouts. I will publish the data in my Master's thesis prepared as several manuscripts for publication. Much of the data collected in 2004 will be analyzed using information-theoretic model selection methods described by Burnham and Anderson (2002). I will construct models that describe dependant variables such as nest box selection and success, cicada emergence density, and growth and survival of post-fire vegetation. Candidate models will include combinations of independent variables such as arthropod and vegetation measurements as well as abiotic variables (e.g., climate and soil characteristics). I will use Akaike's information criterion (AIC) to select from among candidate models those that best fit my data (Burnham and Anderson 2002). Best-fit models will identify variables in need of management concern. Publications from this project will provide the foundation of ecological literature dealing with wildfire effects on riparian habitat.

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Table 1. Summary of research activity in 2004.

Variable	Rio Grande Complex Fire	Chavez Fire	San Francisco Fire	San Pedro Fire
Site Data				
Land manager	MRGCD	MRGCD	MRGCD	BNWR
Year of wildfire	2000	2002	2003	1996
Size of wildfire study areas (hectares)	31.44	9.4	20	22.1
Years adjacent unburned plot monitored	2003-2004	2003-2004	2004	2003-2004
Nest Boxes				
No. of nest boxes in wildfire	11	14	13	16
No. of nest boxes in unburned	10	13	13	9
Arthropod Sampling				
Pitfall traps in wildfire	6 days at each nest	6 days at each nest	6 days at each nest	6 days at each nest
Pitfall traps in unburned	6 days at each nest	6 days at each nest	6 days at each nest	6 days at each nest
Number of cicada traps in wildfire	None	14	14	13
Number of cicada traps in unburned	None	14	14	11
Vegetation Sampling				
Nest vegetation	Yes	Yes	Yes	Yes
Growth and survival of re-sprouts in wildfires	50 stems located and re-measured	61 stems located and re-measured	64 stems located and re-measured	79 stems located and re-measured
Cicada trap vegetation	No	Yes	Yes	Yes

Table 2. The number of re-sprouting stems of each species marked in each wildfire plot in 2003.

Species	Bernardo 2003 Fire	Chavez 2002 Fire	Rio Grande Complex 2000 Fire	San Pedro 1996 Fire
Populus deltoids	16	16	10	18
Tamarix ramosissima	20	16	6	23
Eleganus angustifolia	10	8	7	5
Salix goodingii	5	14	5	2
Baccharis glutinosa	2	0	0	21
Salix exigua	3	0	12	4
Morus alba	0	0	8	0
Foresteria neomexicana	0	5	0	2
Amorpha fruticosa	4	0	0	2
Lycium torreyi	4	1	0	1
Ulmus pumila	0	0	3	0
Ailanthus altissima	0	1	2	0
Prosopis pubescens	0	0	0	1

Table 3. Survival of re-sprouted cottonwood and saltcedar stems in wildfire sites from 2003 to 2004 (UO – Joint Venture)

Site	Year of wildfire	% Cottonwood Survival	% Saltcedar survival
Bernardo	2003	40%	100%
Chavez	2002	79%	100%
Rio Grande Complex	2000	100%	100%
San Pedro	1996	83%	100%

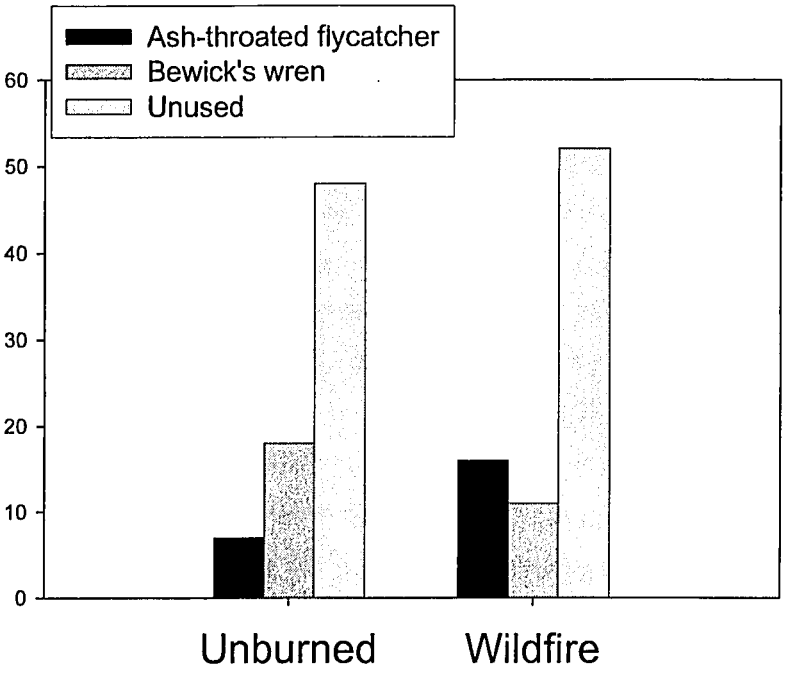

Figure 1. The number of nest boxes used by Bewick's Wrens and Ash-throated Flycatchers in 2003 and 2004.

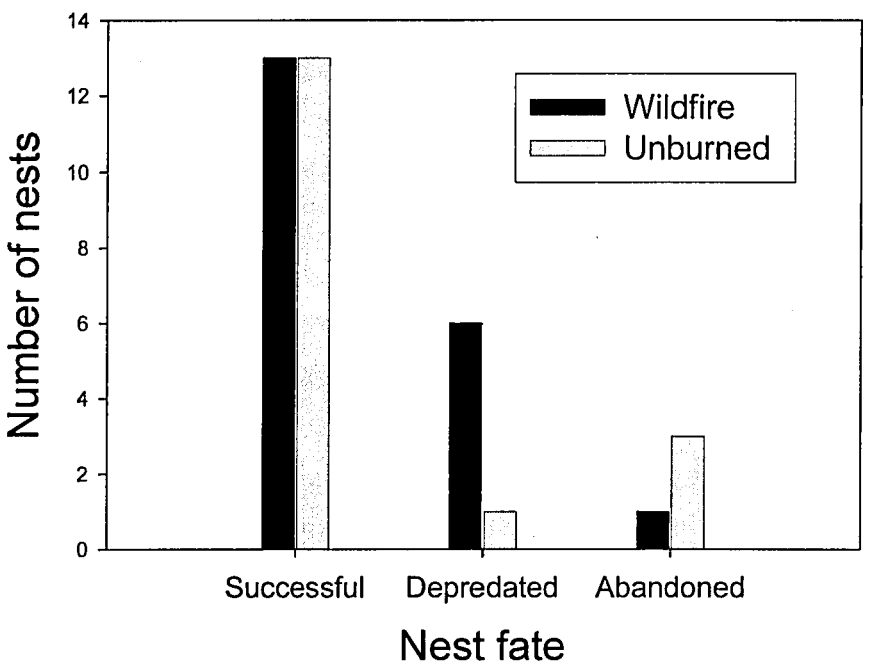

Figure 2. Fates of Ash-throated Flycatchers and Bewick's Wren nests in 2004 at wildfire and unburned sites.

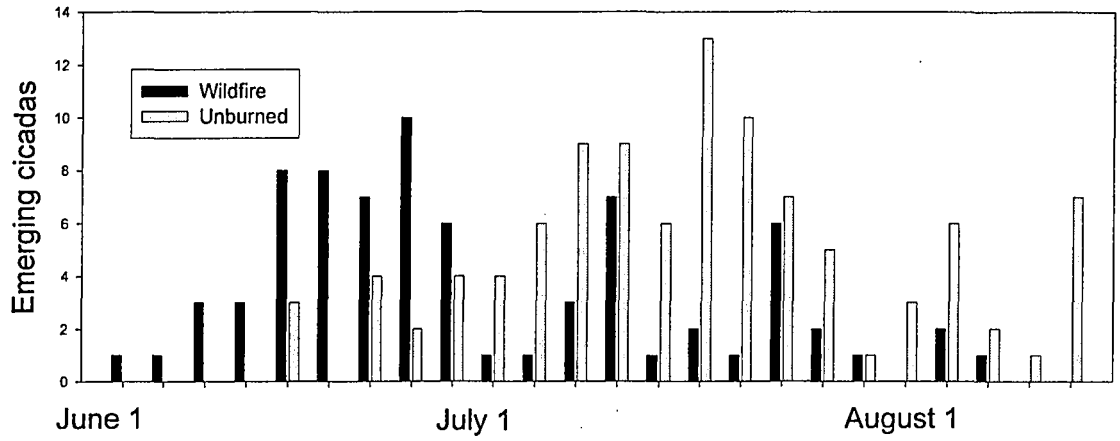

Figure 3. The number of cicadas emerging in wildfire and unburned sites by date in 2004.